

DESCRIPTION AND LIFE CYCLE OF A NEW SPECIES OF  
*HISTIOSTOMA* (ACARI: HISTIOSTOMIDAE) ASSOCIATED  
WITH COMMERCIAL MUSHROOM PRODUCTION

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*Abstract.*—The immature and adult stages of a new species of Histiotomidae, *Histiostoma heinemanni*, associated with commercial mushroom production, are described and compared with those of *H. feroniarum* (Dufour). Methods for rearing *H. heinemanni*, data on its biology and evidence that it may spread mushroom pathogens are presented.

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While collecting mites from commercial mushroom beds and compost piles in Chester County, Pennsylvania, we frequently found adult and immature stages of new species of *Histiostoma*, almost identical with *H. feroniarum* (Dufour). *Histiostoma feroniarum*, which has also been found on mushrooms as well as in many other habitats, has been redescribed by Scheucher (1957), Hughes and Jackson (1958), and Jary and Stapeley (1936) under the name *Histiostoma rostro-serratum* (Megnin). Hughes (1976) synonymized *Anoetus* under *Histiostoma*. We are using her nomenclature for the idisomal structures.

This work was done in collaboration with the Systematic Entomology Laboratory, IIBIII, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Maryland 20705. We undertook laboratory breeding experiments to study the life-cycle of the new species of *Histiostoma* and to collect all stages so that they could be described and figured.

Methods of Rearing and Course of Development

*Histiostoma* species have been associated with environments with high relative humidity. Rearing experiments were started by transferring groups of hypopi to petri dishes containing potato-dextrose agar and some decaying potato that served as food. The dishes were sealed with tape to prevent the hypopi from escaping and then placed in an incubator at 27°C. Some hypopi entered the quiescent stage within a few hours after being transferred to the dishes. The first tritonymphs were seen on the 2nd day and the first eggs were seen on the 4th day. The females selected dry and compacted material on which to lay eggs, either singly or in small clusters. The first larvae were seen on the 5th day and the first protonymphs were seen on the 6th day. Without overpopulation or food depletion the hypopus stage was omitted and the first tritonymphs were seen on the 7th day. Increasing numbers of hypopi were found in dishes kept from 4-6 weeks. Like Scheucher (1957), we saw hypopi standing on legs III and IV and making

searching movements with legs I and II, apparently ready to attach to the moving objects, usually insects by which they are dispersed.

Parthenogenesis experiments were like the rearing experiments except that only one hypopus was put in each petri dish. Only two of these hypopi out of approximately 30 specimens developed into adult females that laid eggs. Cultures became infested with fungi, which probably prevented the development of these stages. Eggs of one of these females gave rise to three tritonymphs, fourteen heteromorphic males and two homeomorphic males; eggs of the other gave rise to one tritonymph, twenty-two heteromorphic males and twelve homeomorphic males.

*Histiostoma heinemanni* Hill and Deahl, new species

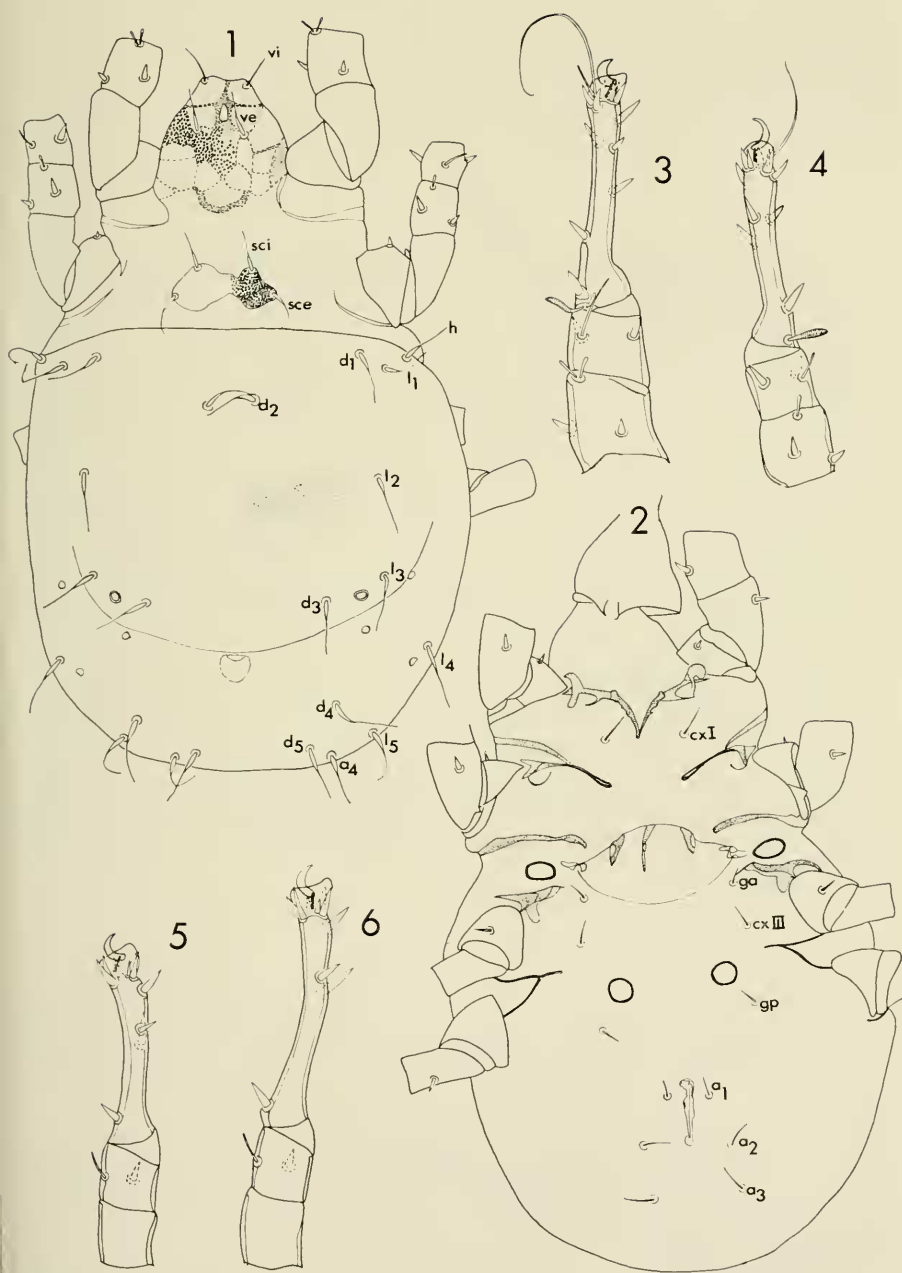
*Diagnosis*.—The adults and immatures of *Histiostoma heinemanni* can easily be distinguished from those of other *Histiostoma* spp. by the platelet (pl) located between scapular internal setae (sci) and scapular setae (sce) (Fig. 1). Gnathosoma (Figs. 36–37): Gnathosoma identical in immatures and adults, except for size. Chelicerae (Fig. 36) bifurcate distally with 6 small teeth and laterally with 9 larger teeth; flagellum present; proximal part of digitus fixus (df) with 3 projections; digitus mobilis (dm) smaller than df. Pedipalps (p) (Fig. 37) with 2 flagella, subequal in length; membranous structure present on venter of pedipalps.

Female  
Figs. 1–6

*Holotype*.—Idiosoma pyriform, 440  $\mu$  long and 227  $\mu$  wide; length of paratypes (10) averages 363 (279–467)  $\mu$  long and 203 (147–267)  $\mu$  wide; cuticle with fine projections.

*Dorsum* (Fig. 1).—Anterior of propodosoma sculptured; vertical internal setae (vi) in front of vertical external (ve); vi not enlarged basally; sci in front of sce; sci and sce border platelet (pl). All prodosomal setae subequal in length. Dorsal propodosoma and hysterosoma separated by transverse groove. Setae  $d_1$ ,  $d_5$ ,  $l_1$ – $l_5$  and h smooth with enlarged bases and slender distally. Oil gland between  $d_3$  and  $l_3$ ; 3 pores in same region. Bursa copulatrix dorsal, located about  $\frac{1}{6}$  the length of the hysterosoma from caudal end.

*Venter* (Fig. 2).—Epimera I Y-shaped. Transverse genital opening between coxae II and III. Two pairs of almost circular rings, anterior pair between coxae II and III, posterior pair at level of coxae IV. Setae cx III slightly shorter and finer than cx I; setae ga and gp subequal in length and somewhat longer than  $\frac{1}{2}$  the length of cx I; setae gp and subequal in length; setae  $a_2$  and  $a_3$  slightly shorter than  $2\times$  the length of  $a_1$ ;  $a_4$  (Fig. 1) slightly shorter than  $3\times$  the length of  $a_1$ .



Figs. 1-6. *Histiostoma heinemanni*, female. 1. Dorsum; 2. Venter; 3-6. Respectively, legs I-IV.

*Legs* (Figs. 3-6).—With 5 free segments; tarsi relatively long, with stout claw originating in short pretarsus. All setae spinelike. Chaetotaxy: Tarsi, 13-12-10-10; tibiae, 2-2-1-1; genua, 2-2-0-0; femora, 1-1-0-1; trochanters 1-1-1-0. Solenidiotaxy: Tarsi, 3-1-0-0; tibiae, 1-1-1-1; genua, 2-1-0-0. For trochanters and femora see Figs. 1 and 2.

#### Male Figs. 7-12

Two types of males are present in the cultures: Homeomorphic males with normal size spines on tarsus II and heteromorphic males with two enlarged spines on tarsus II. Intermediate stages are found. Idiosoma of 8 heteromorphic males averages 298 (255-319)  $\mu$  long and 147 (128-160)  $\mu$  wide. Idiosoma of 7 homeomorphic males averages 262 (230-287)  $\mu$  long and 127 (121-134)  $\mu$  wide. Idiosoma more rectangular and smaller than in females; cuticle covered with small projections.

*Dorsum* (Fig. 7).—Anterior of propodosoma sculptured; setae vi in front of ve; sculptured platelet (pl) bordered by setae sci and sce. All propodosomal setae subequal in length, enlarged basally except vi slender distally. Hysterosomal setae  $d_1$ - $d_5$ ,  $l_1$ - $l_5$  and h correspond with those of female in relative size and distribution, but setae  $d_4$  are absent. Oil gland between setae  $d_3$  and  $l_3$ ; pore at level of  $l_1$ .

*Venter* (Fig. 8).—Four chitinous ringlike structures at level of coxae IV. Arrangement of setae and epimera as in female. Genitalia located about  $\frac{1}{6}$  the length of the hysterosoma from caudal end; 2 pairs of internal setae, the shorter located more dorsally, and 4 pairs of anal setae.

*Legs* (Figs. 9-12).—Tarsi broader and shorter than in female. Chaetotaxy and solenidiotaxy as in female, except for tarsus I, which has 10 setae and 2 solenidia.

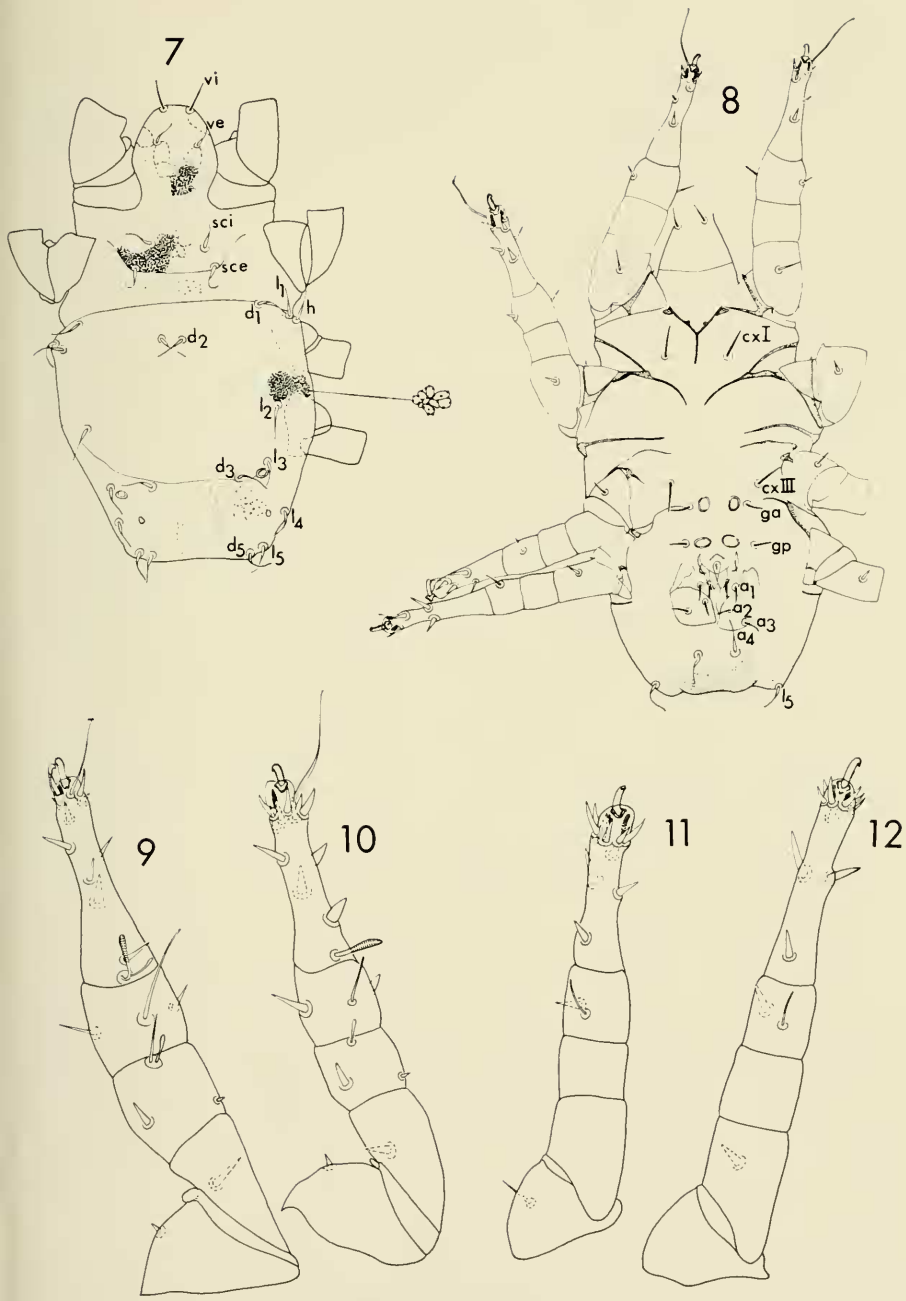
#### Tritonymph Figs. 13-18

Idiosoma and gnathosoma of 10 specimens average 223 (121-294)  $\mu$  long and 133 (70-185)  $\mu$  wide. The rather large variation in measurements probably reflects the presence of both male- and female-forming tritonymphs.

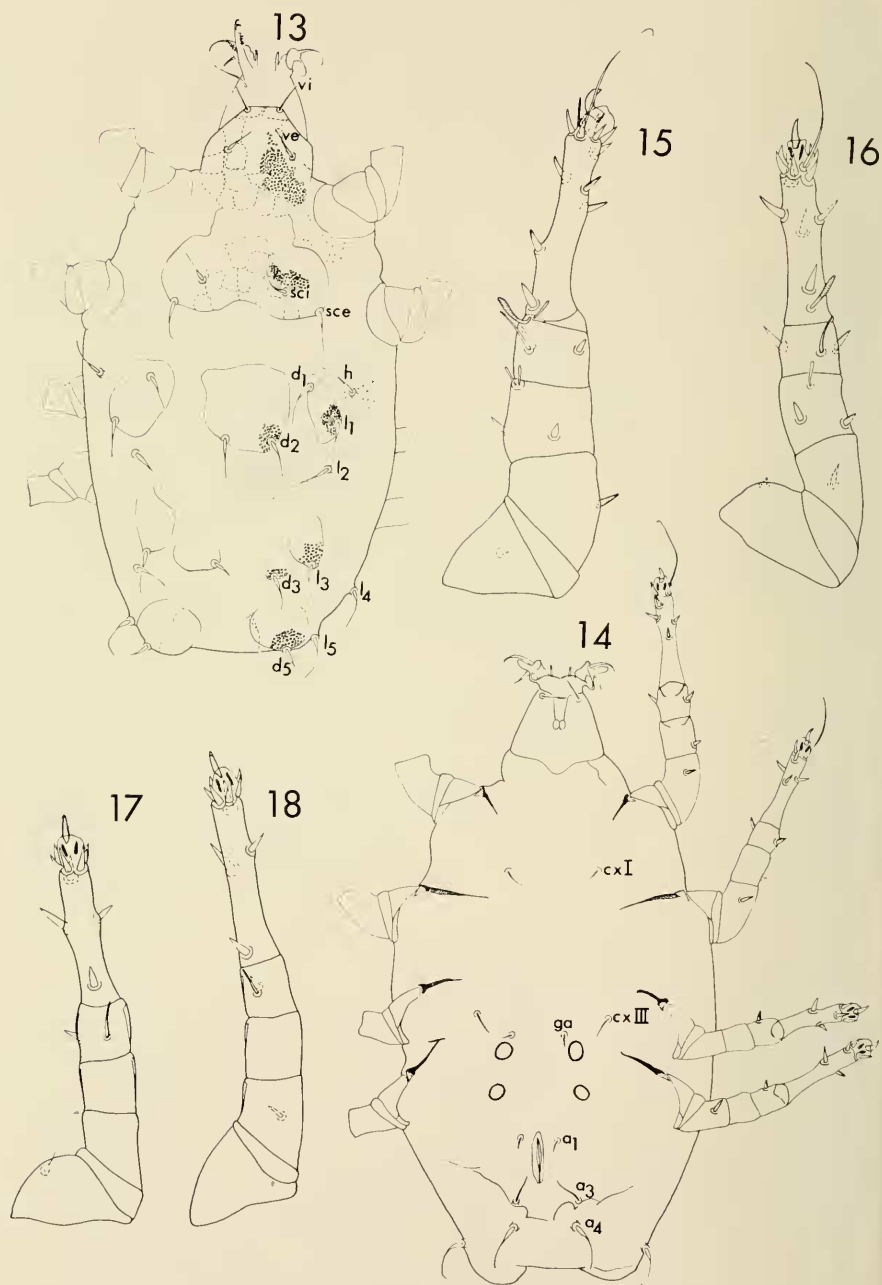
*Dorsum* (Fig. 13).—Anterior of propodosoma and platelet (pl) connected, both sculptured. Type, arrangement and relative size of dorsal setae similar to those of female; setae  $d_4$  missing; dorsal setae located on distinct bosses. Dorsal pores missing.

*Venter* (Fig. 14).—Two pairs of sclerotic ringlike structures at level of coxae IV. Setae ga above anterior ringlike structure. Chaetotaxy similar to that of female, but gp lacking. No sexual structures.

*Legs* (Figs. 15-18).—Chaetotaxy and solenidiotaxy as in female.



Figs. 7-12. *Histiostoma heinemanni*, male. 7. Dorsum; 8. Venter; 9-12. Respectively, legs I-IV.



Figs. 13-18. *Histiostoma heinemanni*, tritonymph. 13. Dorsum; 14. Venter; 15-18. Respectively, legs I-IV.

### Hypopus Figs. 19-24

Idiosoma of 10 specimens averages 81 (103-217)  $\mu$  long and 138 (74-160)  $\mu$  wide.

*Gnathosoma* (Fig. 20).—Elongate; ratio correlation of length; width is 1:4; 1 pair of flagellum longer than gnathosoma; anterolateral pair of short setae present.

*Dorsum* (Fig. 19).—Propodosoma broad; anterior of propodosoma with interrupted groove (as figured); setae vi in front of ve. Transverse groove complete, posterior with broken-line area. Hysterosoma oval shaped; posterior broadly rounded; surface smooth. Dorsal setae short, setiform, subequal in length.

*Venter* (Fig. 20).—Epimera I fused medially; sternum free posteriorly, epimera II connected with epimera III by a fine sclerotized extension from latter; epimera III free; posterior and anterior of posterior sternum free. Suckers on epimera II on coxal plate III, and laterad on genital area. Setae sh, genital setae, and "anal setae" small and setiform. Anal opening located about  $\frac{2}{3}$  the length of the suctorial plate from caudal end.

*Chaetotaxy of legs* (Figs. 21-24).—Tarsi, 8-9; tibiae, 2-2; tibiotarsi, 7-7; genua, 3-2-2; femora, 1-1-0-1; trochanters 0-0-1-0. Solenidiotaxy: Tarsi, 3-1; tibiae, 0-1; genua, 0-1-0.

### Protonymph Figs. 25-30

Average length of idiosoma of 7 specimens: 221 (160-262)  $\mu$  long and 124 (108-134)  $\mu$  wide; cuticle punctate.

*Dorsum* (Fig. 25).—Anterior of propodosoma sculptured; platelet (pl) bordered by setae sci and sce. Dorsal chaetotaxy as in female, but setae relatively smaller.

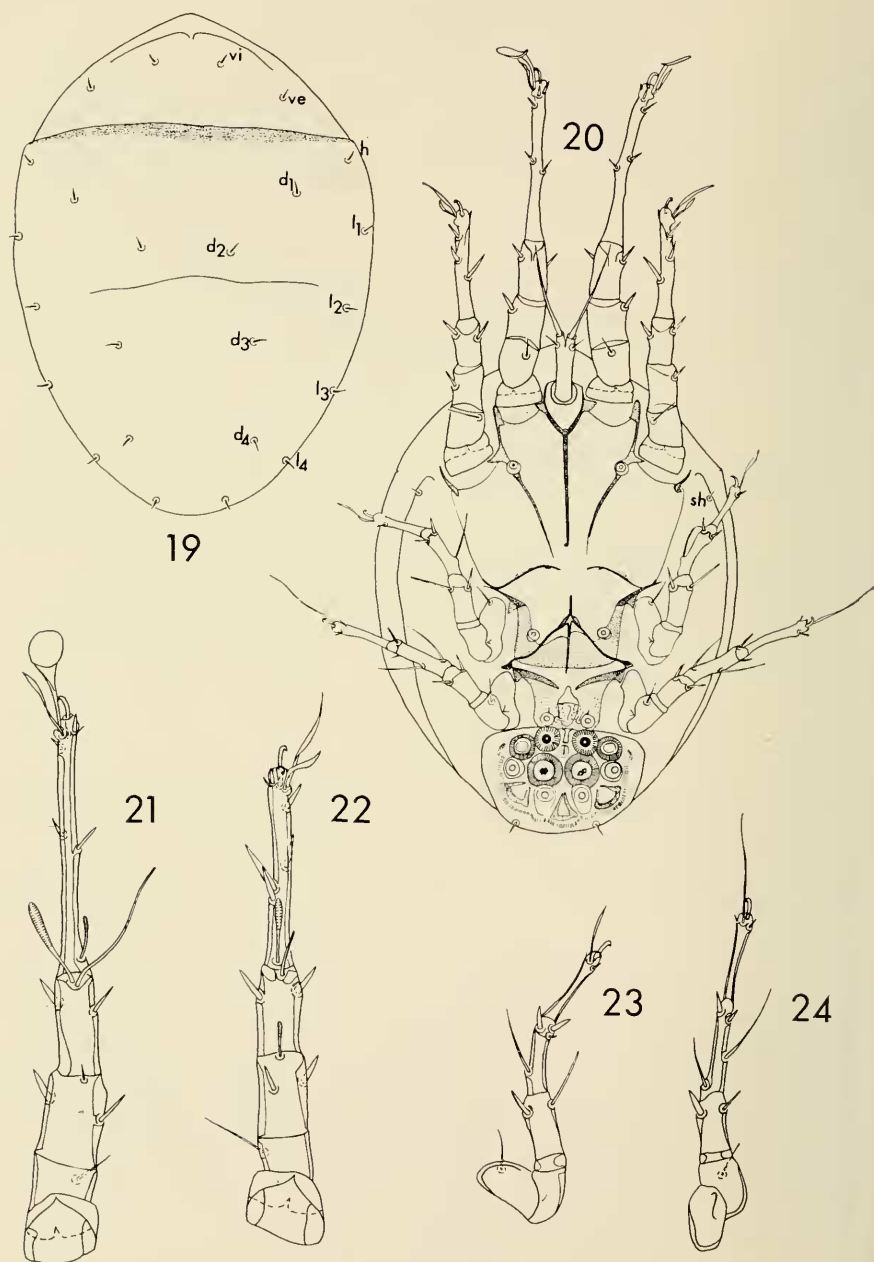
*Venter* (Fig. 26).—One pair of sclerotic ringlike structures at level of coxae IV. No sexual structures present. Chaetotaxy as in female, but setae ga and gp lacking.

*Leg* (Figs. 27-30).—Legs differ from those of female in lack of spines on trochanters I-III; leg IV differs also in absence of spine and famulus on tibia and absence of 3 spines around pretarsus. Chaetotaxy: Tarsi, 13-12-10-7; tibiae, 2-2-1-0; genua, 2-2-0-0; femora, 1-1-0-0; trochanters 0-0-0-0. Solenidiotaxy: Tarsi, 2-1-0-0; tibiae, 1-1-1-0; genua, 2-1-0-0.

### Larva Figs. 31-35

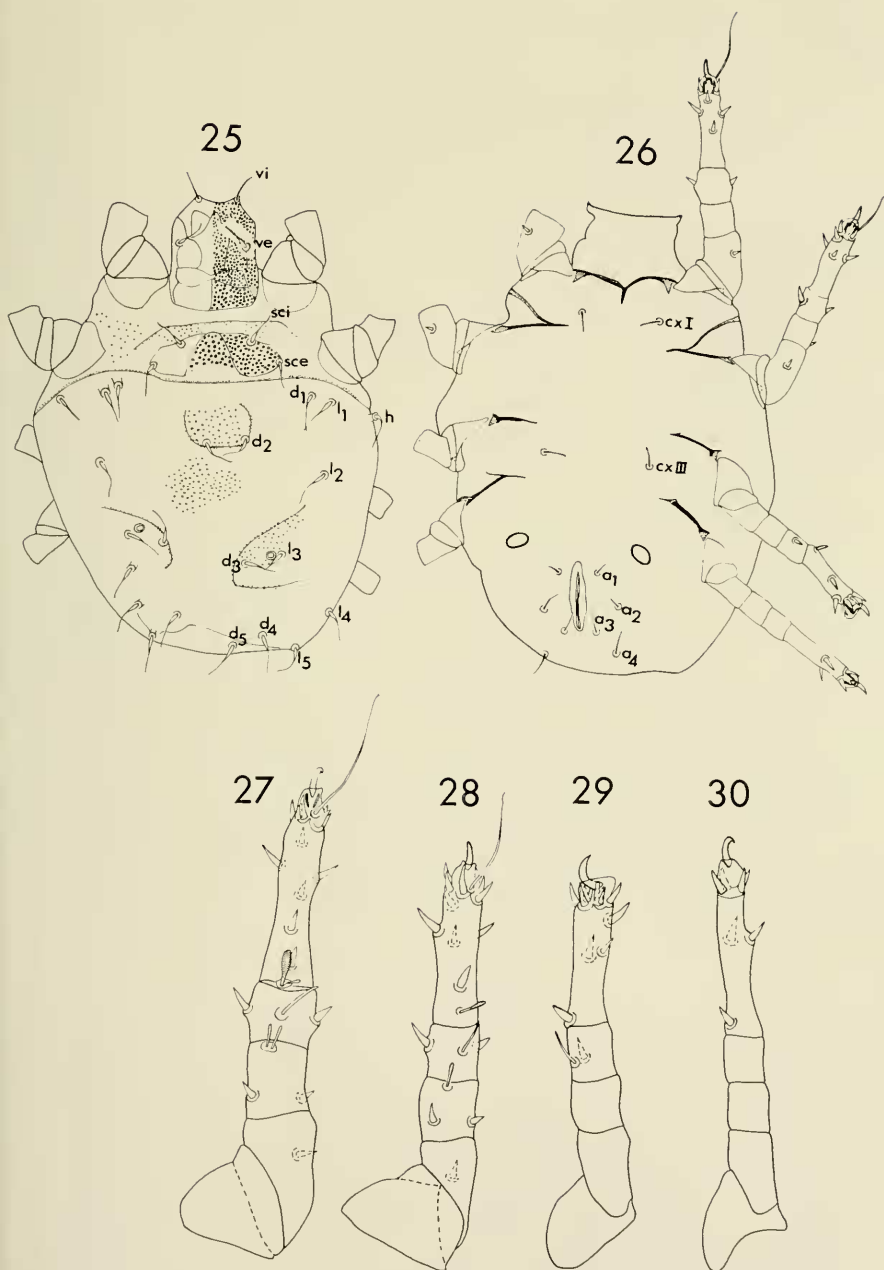
Idiosoma of 8 specimens averages 160 (109-185)  $\mu$  long and 93 (76-109)  $\mu$  wide.





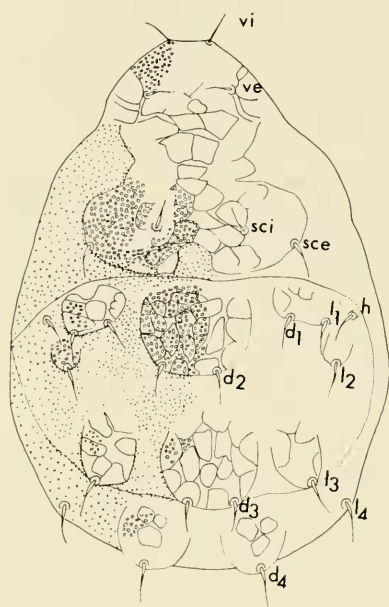
Figs. 19-24. *Histiotoma heinemanni*, hypopus. 19. Dorsum; 20. Venter; 21-24. Respectively, legs I-IV.



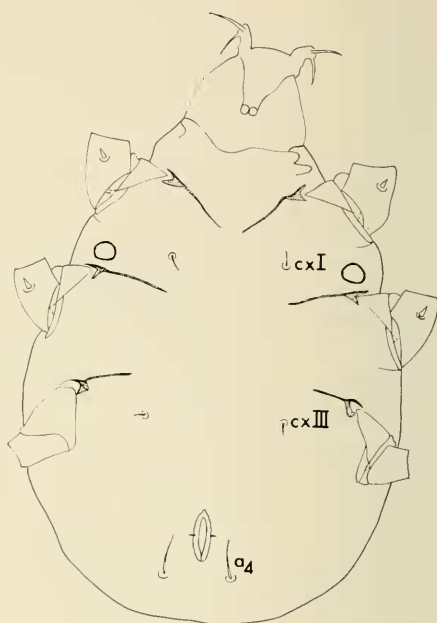


Figs. 25–30. *Histiostoma heinemanni*, protonymph. 25. Dorsum; 26. Venter; 27–30. Respectively, legs I–IV.

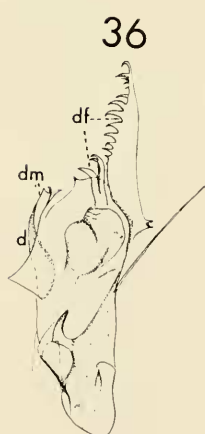
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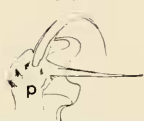
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37



Figs. 31–35. *Histiostoma heinemanni*, larva. 31. Dorsum; 32. Venter; 33–35. Respectively, legs I–III. Figs. 36–37. *Histiostoma heinemanni*, gnathosoma of all stages.

*Dorsum* (Fig. 31).—Anterior of propodosoma sculptured and contiguous with sculptured platelet (pl). Dorsal setae on distinct sculptured bosses. Chaetotaxy as in female, but  $d_5$  and  $l_5$  absent.

*Venter* (Fig. 32).—One pair of chitinous ringlike structures anterior to coxae II. Setae  $cx$  I,  $cx$  III and  $a_4$  present; setae  $a_1$ – $a_3$ ,  $ga$  and  $gp$  absent.

*Legs* (Figs. 33–35).—Leg I differs from that of female in absence of spine on trochanter, 1 solenidion on tarsus, and famulus on pretarsus; legs II and III differ in absence of spine on trochanter. Chaetotaxy: Tarsi, 13-12-10; tibiae, 2-2-1; genua, 2-2-0; femora, 1-1-0; trochanters, 0-0-0. Solenidiotaxy: Tarsi, 1-1-0; tibiae, 1-1-1; genua, 2-1-0.

*Deposition of type material*.—Holotype: Female, USNM No. 3836 from mushroom compost from the mushroom farm of R. Dowell, Toughkenamon, Pennsylvania, 8 August 1976, by A. Hill and K. L. Deahl. Paratypes were collected from horse manure, first-stage mushroom and mushroom compost in Chester County, Pennsylvania as follows: R. Dowell, Toughkenamon, 8 August 1976; P. Yeatman, Avondale, 13 October 1976; Keystone Company, Coatesville, 31 August 1976; G. Guizetti, Toughkenamon, 15 September 1976; C. Nigro, Cochranville, 8 August 1976. Hypopi were also collected from phorid flies caught in the mushroom houses. We also obtained several stages from the Experimental Mushroom House, BARC-West, USDA, Beltsville, Maryland. Paratypes are deposited with the following: U.S. National Museum of Natural History, Washington, D.C.; Institute de Medecine Tropicale, Antwerp, Belgium; Ryksmuseum van Natuurlijke Historie, Leiden, Netherlands; Dr. R. L. Heinemann, Longwood College, Farmville, Virginia; Acarology Laboratory, Ohio State University, Columbus, Ohio; Catholic University, Nijmegen, Netherlands; Hungarian Natural History Museum, Budapest, Hungary.

*Etymology*.—This species is named for Dr. R. L. Heinemann, Longwood College, Farmville, Virginia.

### Discussion

In the family Histiotomidae, the generic classification has been based on the hypopus stage. Differences between hypopi can be minute and older descriptions were sometimes incomplete, so identification has been difficult. Except for the absence of the broken-line area posterior to the transverse groove and contiguity of the epimera IV, the hypopus of *H. feroniarum* described by Scheucher (1957) is identical with hypopus of *H. heinemanni* in that the former has an extra pair of dorsal setae and one sensory seta on tarsus I instead of two.

A significant difference between the two species is the presence of a platelet on the dorsal propodosoma of adults and developmental stages of the species only, this platelet has not been described previously. The form of the platelet is probably growth dependent because the platelet is some-

times medially split into two or nearly so. In some specimens (Fig. 13) the platelet is connected with the anterior sculptured part of the propodosoma, but usually it is separate and bordered by setae *sci* and *see*. Compatible with previous descriptions are dorsal bosses, obvious in the development stages but also readily visible in the adults.

For *H. feroniarum*, Scheucher (1957) shows 11 pairs of dorsal setae and 3 pairs of anal setae in the female and the male; Hughes and Jackson (1958) show 12 pairs of dorsal setae in the female and 11 in the male, and 3 pairs of anal setae for both. *Histiostoma heinemanni* has 11 pairs of dorsal and 4 pairs of anal setae in the female and 10 pairs of dorsal and 4 pairs of anal setae in the male. Also, Scheucher (1957) figures only 1 sensory seta on tarsus I of the female of *H. feroniarum*, whereas 2 sensory setae are present on tarsus I of the female of *H. feroniarum*, as described by Hughes and Jackson (1958), and on tarsus I of the female of *H. heinemanni*, as described here. Furthermore, Scheucher (1957) describes a second claw lacking in other descriptions on tarsi I and II of the male of *H. feroniarum*. The life cycle of *H. heinemanni* seems very similar to that described for *H. feroniarum* except that we found both homeomorphic and heteromorphic males in the culture, whereas Scheucher (1957) found only heteromorphic males of *H. feroniarum*. The difference could be inherent in the species or could be a result of environmental conditions. In the mushroom houses we frequently saw many *H. heinemanni* on mushrooms that were decaying as a result of infection with *Verticillium malthousei* Ware, *Pseudomonas tolaasii* Paine (Deahl, unpublished) and various secondary saprophytic invaders. *Histiostoma heinemanni* apparently does not feed on the mushroom tissue but is probably attracted by the presence of the microorganisms. However, by feeding on the microorganisms, this mite may be important in the spread of diseases. Only one species, *Histiostoma gracilipes* (Banks) is known to injure mushrooms by feeding on the spawn (Compton, 1933).

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